Computer Graphics (CUE31045)

1. Information on the Programme

1.1. Higher Education Institution	Cihan University Sulaimaniya
1.2. College	Science
1.3. Department	Computer Science
1.4. Field of Study	Computer Graphics
1.5. Cycle of Study[1]	1
1.6. Specialization/ Study Programme	Computer Science
1.7. Form of Education	Full Time

2. Information on the Discipline

2.1. Discipline Name	Computer Graphics							
2.2. Code	CUE31045							
2.3. Language:	English							
2.4. (Theory) Lecturer **E-mail:** **Tel:** **Webpage, Google Classroom**	Dr. Asan Baker Kanbar **asan.baker@sulicihan.edu.krd** 07702396919							
2.5. Practical/Seminar/ Laboratory/ Project Lecturer **e-mail:** **Tel:** **Webpage, Google Classroom**	Dr. Asan Baker Kanbar **asan.baker@sulicihan.edu.krd** 07702396919							
2.6. Year of Study	-2022 2023	2.7 .Semester	1st	2.8. Assessment Type[2]	Written exam, & CE	2.9. Discipline Status	Content[3]	CD
							Mandotary[4]	MD

3. Total estimated time (Teaching Hours per Semester)

College of Science	
Department:	**Computer Science Department**
Decipline:	**Web Programming**
Stage:	**3rd**

Total Contact Hours:	**52**
Total Self Study Hours:	**110**
Total No. Hours:	**162**
ECTS:	**6.00**

No. of Weeks	Contact Hours					Self Study					
	Theoretical	Practical	Lab.	Tutorial	Visit	Quiz	Reading	Assignment	Report	Midterm Exam.	Final Exam.
1st Week (Registration)	-	-	-	-	-	-	-	-	-	-	-
2nd Week	2		2				2			10	20
3rd Week	2		2				2	3			
4th Week	2		2			3	2				
5th Week	2		2				2	3			
6th Week	2		2			3	5		5		
7th Week	2		2				2				
8th Week	2		2				2			10	
9th Week	2		2				2	3			
10th Week	2		2			3	4		5		
11th Week	2		2				2				
12th Week	2		2				2	3			
13th Week	2		2			3	4				
14th Week	2		2				5				
15th Week (Final Exam.)		-	-	-	-	-	-	-	-	-	-
16th Week (Final Exam.)	-	-	-	-	-	-	-	-	-	-	-
TOTAL	26	0	26	0	0	12	36	12	10	20	20

4. Prerequisites (if applicable)

4.1 Curriculum-Related	The curriculum covers computer graphics principles, including 2D/3D graphics rendering, image processing, geometric transformations, shading, lighting, and animation techniques, to understand and create visually immersive computer-generated graphics.
4.2 Skills-Related	Develop expertise in computer graphics skills, including 2D/3D rendering, image processing, geometric transformations, shading, lighting, texture mapping, and animation, to create visually captivating and realistic computer-generated graphics.

5. Conditions (if applicable)

5.1. For the Theoretical	1. Read and comprehend the textbook material. 2. Attend all the classes and take notes on class discussions. 3. Actively participate in class discussions and activities. 4. Submit all the assignments and the project on time. 5. Pass tests and quizzes.

5.2. For the Practical	All students are normally required to attend the Lab; take part in lectures through applying the exercises on the computer or as quizzes, and to implement projects.

6. Cumulated Specific Competences

Professional Competencies	▪ Proficiency in Graphics Programming: Ability to write efficient and optimized code for rendering, transformation, and manipulation of graphics using programming languages like OpenGL, DirectX, or WebGL. ▪ Understanding of Computer Graphics Algorithms: Familiarity with fundamental algorithms and techniques used in computer graphics, including rasterization, ray tracing, texture mapping, shading models, and geometric transformations. ▪ Visual Design and Aesthetics: Knowledge of visual design principles, color theory, typography, and composition to create visually appealing and aesthetically pleasing graphics. ▪ Problem Solving and Debugging: Strong problem-solving skills to identify and resolve issues related to graphics rendering, performance optimization, compatibility, or visual artifacts encountered during the development of computer graphics applications.
Transversal competences	• Creativity and Innovation: The ability to think creatively and come up with innovative ideas for designing and implementing visually engaging and unique computer graphics solutions. • Attention to Detail: A keen eye for detail to ensure precision in graphics rendering, accurate color representation, smooth animations, and overall visual quality in computer graphics projects. • Communication and Collaboration: Effective communication skills to work collaboratively with clients, team members, and stakeholders, understanding their requirements and translating them into visually appealing graphics. • Problem Solving and Adaptability: Strong problem-solving skills and adaptability to handle challenges and unexpected issues that may arise during the development of computer graphics projects, finding alternative solutions and adapting to changing requirements. • Continuous Learning and Research: The willingness to stay updated with the latest trends, technologies, and techniques in computer graphics through continuous learning and research, enabling the incorporation of cutting-edge practices and tools into graphics projects.

7. Discipline Objectives (Based on the cumulated specific Competences)

7.1. General Objective	• Broad Knowledge of Graphics Systems: Gain a comprehensive understanding of the components and architecture of computer graphics systems, including hardware, software, and the interaction between them. • Visual Representation: Creating visually appealing and realistic representations of objects, scenes, or data through the use of computer-

	generated imagery. • Creative Application of Graphics Techniques: Develop the ability to creatively apply computer graphics techniques to various fields, such as gaming, animation, virtual reality, scientific visualization, and user interface design. • Interdisciplinary Integration: Cultivate the skills to integrate knowledge from other disciplines, such as computer science, mathematics, and art, to create visually compelling and technically sound graphics applications. • Adaptability to Emerging Technologies: Build a foundation that allows for adaptability and continuous learning in the rapidly evolving field of computer graphics, enabling the use of new tools, frameworks, and methods as they emerge. • Ethical and Social Awareness: Foster an understanding of the ethical and social implications of computer graphics, particularly in areas like digital content creation, media representation, and the potential impact on society. • Collaboration and Communication Skills: Enhance the ability to work effectively in teams, communicate complex technical concepts clearly, and collaborate on projects that require both
7.2. Specific Objectives	• Understanding Fundamental Concepts: Gain a thorough understanding of the basic principles of computer graphics, including the mathematical foundations, graphics systems, and the graphics pipeline. • Developing Problem-Solving Skills: Learn to analyze and solve problems related to rendering, modeling, and transforming graphical objects in both 2D and 3D environments. • Proficiency in OpenGL Programming: Acquire hands-on experience in using OpenGL for creating interactive graphics applications, including the ability to implement shaders, texture mapping, and lighting effects. • Mastering Graphics Algorithms: Understand and implement key algorithms used in computer graphics, such as clipping, rasterization, and ray tracing, to generate realistic images. • Applying Mathematical Techniques: Develop the ability to apply linear algebra, geometry, and calculus in the context of computer graphics to perform transformations, projections, and other graphics operations. • Creating Real-Time Graphics Applications: Learn to design and develop real-time graphics applications, such as simulations and games, by integrating various graphics techniques and optimizing performance.

8. Content

week	8.1. Theoretical-Number of Hours	Teaching methods	Observation

1	registration		
2	Introduction to Computer Graphics • Overview of Computer Graphics • Applications and History • Basic Concepts: Pixels, Resolution, Coordinate Systems	lecture	**1 lecture = 2 hours**
3	Graphics Systems and Models • Raster Graphics vs. Vector Graphics • Graphics Pipeline • Display Devices and Graphics Software	lecture, assignment	**1 lecture = 2 hours**
4	Mathematics for Computer Graphics • Linear Algebra: Vectors, Matrices • Transformations: Translation, Rotation, Scaling • Homogeneous Coordinates •	lecture, Quiz	**1 lecture = 2 hours**
5	2D Graphics • 2D Transformations and Viewing • Filling Techniques (Scan-line Algorithm)	lecture,	**1 lecture = 2 hours**
6	3D Graphics Basics • 3D Coordinate Systems • 3D Transformations: Translation, Rotation, Scaling • Projections: Perspective and Orthographic	Lecture (report1)	**1 lecture = 2 hours**
7	**MIDTERM EXAM 1**		
8	Viewing in 3D • Viewing Pipeline • Camera Models • Viewport Transformation •	Lecture	**1 lecture = 2 hours**
9	• Illumination and Shading • Light Sources and Illumination Models • Shading Models: Flat, Gouraud, Phong • Introduction to Reflection Models	lecture, Assignment	**1 lecture = 2 hours**
10	• Texture Mapping • Basics of Texture Mapping • Texture Filtering and Wrapping • Bump Mapping and Environment Mapping	Lecture,Quiz (report2)	**1 lecture = 2 hours**

11	**MIDTERM EXAM 2**		
12	Rendering Techniques • Z-buffer and A-buffer Algorithms • Ray Tracing Basics • Radiosity	lecture,	**1 lecture = 2 hours**
13	Curves and Surfaces • Parametric Curves and Surfaces (Bezier, B-Splines) • Subdivision Surfaces • Surface Tessellation	lecture,	**1 lecture = 2 hours**
14	Curves and Surfaces • Parametric Curves and Surfaces (Bezier, B-Splines) • Subdivision Surfaces • Surface Tessellation •	lecture	**1 lecture = 2 hours**

week	**8.2. Practical Works–Number of Hours**	**Teaching methods**	**Observation**
1	registration		
2	Introduction to OpenGL • Setting up OpenGL Development Environment • First OpenGL Program (Drawing a Simple Shape)	Lecture	**1lecture = 2 hours**
3	Basic Drawing with OpenGL • Drawing Primitives (Points, Lines, Triangles) • Using Color in OpenGL	Lecture,	**1 lecture = 2 hours**
4	2D Transformations in OpenGL • Implementing 2D Transformations (Translation, Rotation, Scaling) • Interactive 2D Graphics	Lecture	**1 lecture = 2 hours**
5	• 3D Graphics in OpenGL • Drawing 3D Primitives • Basic 3D Transformations	Lecture, assignment	**1 lecture = 2 hours**
6	Camera Control in OpenGL • Implementing a Simple Camera • Basic Camera Movements (Pan, Tilt, Zoom) •	Lecture,Quiz	**1 lecture = 2 hours**
7	**MIDTERM EXAM 1**		**2 hours**

8	Lighting and Shading in OpenGL • Implementing Basic Lighting • Shading Techniques in OpenGL	Lecture	**1 lecture = 2 hours**
9	Texture Mapping in OpenGL • Applying Textures to 3D Models • Texture Filtering and Wrapping Techniques	Lecture,	**1 lecture = 2 hours**
10	Rendering Techniques • Implementing Z-buffering • Introduction to Ray Tracing in OpenGL	Lecture	**1 lecture = 2 hours**
11	**MIDTERM EXAM 2**		**2 hours**
12	Curves and Surfaces in OpenGL • Drawing Bezier Curves and Surfaces • Implementing Subdivision Surfaces	Lecture, Assignment	**1 lecture = 2 hours**
13	Implementing a Simple Game using OpenGL • Combining Techniques to Create a Simple 3D Game • User Interaction and Animation	Lecture,Quiz	**1 lecture = 2 hours**
14	Real-Time Rendering Techniques • Implementing Antialiasing • Exploring Real-Time Shadows and Reflections	Lecture,	**1 lecture = 2 hours**

- ***Compulsory Bibliography:***

Key references:

Graphics with OpenGL" by Donald D. Hearn, M. Pauline Baker, and Warren Carithers Interactive Computer Graphics: A Top-Down Approach with OpenGL" by Edward Angel and Dave Shreiner (2017) OpenGL SuperBible: Comprehensive Tutorial and Reference" by Graham Sellers, Richard S. Wright Jr., and Nicholas Haemel (2019)

Optional Bibliography:

9. Assessment

Type of Activity	9.1. Assessment Criteria[2]	9.2. Assessment Type	9.3. Percentage of the final Grade
9.4. Theoretical	Mid-term (20%) Final Exam (35%)	Exam	**%55**
9.5. Practical/	Mid Exam (10%) Final Exam (15%)	Exam	**%25**

9.6. Activity during Semester	Quizzes (10%) + Assignment 5%)+ Report (5%)	Exam	**%20**
Minimum performance Standards:			

Theoretical Lecturer	**Dr. Asan Baker Kanbar**
Practice Lecturer	**Dr. Asan Baker Kanbar**

Approved by the Curriculum development Committee:	
1	
2	
3	
Head of the Department/ Dean	**Dr. Asan Baker Kanbar**